

NASA TECH BRIEF



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Improved Nickel Plating of Inconel X-750

The problem:

Development of a method of applying a plating of nickel, on Inconel X-750 tubing, to serve as a wetting agent during brazing. Previous platings were caused to blister and flake by constituents (such as Co, Ti, and Cr) of the alloy and the heat of brazing ($\geq 2050^{\circ}\text{F}$).

The solution:

A new electroplating technique with acid pickling that leaves a clean surface free from the usual smut resulting from the heat-treated condition, activation that is used for a noncontinuous operation, and a low-stress nickel-plating bath containing none of the organic wetting agents that cause the nickel to blister at high temperatures.

How it's done:

The tubing is degreased before alkaline cleaning, with brushing, for not less than 1.5 min. at from 180° to 210°F ; it is then rinsed. The pickling bath contains 15 to 20% of nitric acid and 3 to 5% of hydrofluoric acid (both by volume), the balance being water. The bath lasts no longer than 20 minutes at no more than 120°F before rinsing.

Activation takes from 30 to 60 s at 70°F in an aqueous solution of (both by volume) 1 to 1.5% nitric acid (42°Be) and 1 to 1.5% hydrofluoric acid (45 to 60% by weight). A nickel strike is made at 70°F in an aqueous solution of nickel chloride at 30 oz/gal and hydrochloric acid at 4.8 oz/gal; the process lasts from 1.5 to 2 mins with a current density of 50 A/ft².

The tubing is then plated to the required thickness in one of two aqueous solutions. The first, at from 115° to 140°F and pH 1.5 to 2.5 (electrometric), contains nickel sulfate at 44 oz/gal, both nickel chloride

and boric acid at 5 oz/gal, and 30% hydrogen peroxide at 0.057 oz/gal daily. The pH, which tends to rise, is lowered with sulfuric acid or raised with nickel carbonate. The current density is from 25 to 100 A/ft².

The alternative plating solution at 100° to 140°F contains nickel sulfamate at 60 oz/gal, boric acid at 4.5 to 6 oz/gal, and 30% hydrogen peroxide at 0.057 oz/gal; the pH is maintained between 3 and 4 (electrometric) with either sulfamic acid or nickel carbonate, and the solution is filtered continuously. The current density is from 40 to 80 A/ft². The plating must be smooth and continuous, with no discoloration indicative of burning.

Stripping of faulty platings and replating are described.

Notes:

1. Electroplaters, and users of Inconel X-750 may be interested.
2. Documentation is available from:
Clearinghouse for Federal Scientific
and Technical Information
Springfield, Virginia 22151
Price \$3.00
Reference: TSP69-10463

Patent status:

No patent action is contemplated by NASA.

Source: C. A. Kuster, J. E. Feeney
and M. E. Farmer of
North American Rockwell Corporation
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